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(54) Grain and seed treatment

(57) A method and apparatus for Micronizing grain and seed, in which the grain or seed is first mixed with water and vibrated in a container (1) so that the grain or seed has a high water content, preferably between 25% and 30% by volume. The wetted grain or seed is then Micronized in the conventional manner in a Micronizing apparatus (4,5). The resulting grain or seed has at least 80% of its starches gelatinised, giving a better quality product.

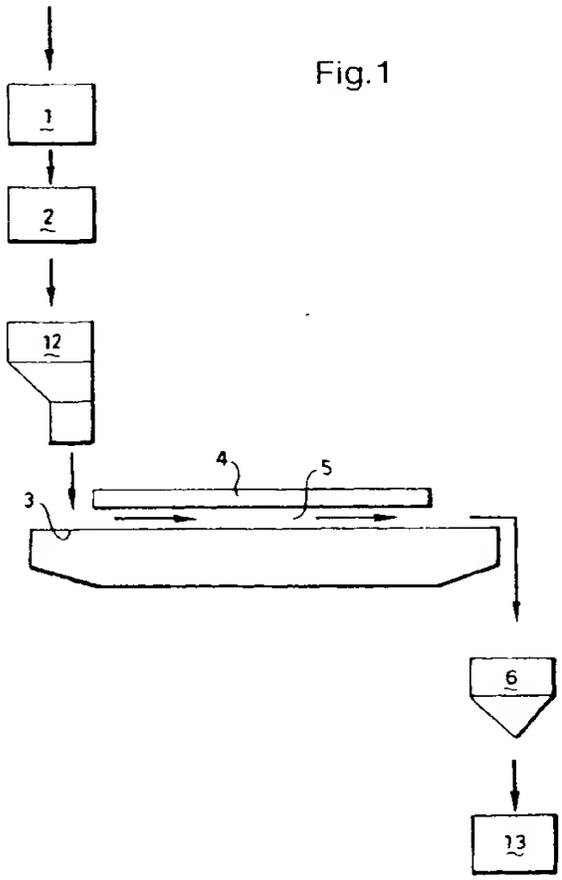

Fig.1

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Description

The present invention relates to Micronizing, and in particular to an improved method and apparatus for Micronizing for the treatment of grain and seed including wheat, oats, barley, maize and soya.

Micronizing is a process carried out on grain or seed in which high intensity infra red radiation is applied to the grain or seed for a short period of time, and which causes the gelatinisation of starches in the grain or seed

Grain and seed have a natural water content, in the case of cereals for consumer foods and animal feed of between around 10% and 14% by volume. By steeping the grain or seed in water, typically overnight, the water content in the grain or seed is raised by between 4% and 7% namely to around 14% to 18% for cereals by steeping once and to around 21% for maize by multiple steeping. The pre-soaked grain or seed is then passed through high intensity infra red radiation, which is generated by gas burners. Typically the grain or seed is in the infra red radiation for up to 1 minute, at a temperature of 90 to 95° C, after which the grain or seed can be flaked by passing through a milling operation. Alternatively, the grain or seed can be treated in the infra red radiation for a longer period of around 90 seconds causing expansion of the grain or seed to produce "torrefied" grain or seed.

By subjecting the grain or seed to the Micronizing process, starch in the grain or seed is gelatinised Typically between 50% and a maximum of 75% of the starch in the grain or seed is gelatinised by the process. The precise amount of starch gelatinisation cannot be accurately controlled, and it is therefore hard to ensure an acceptably high percentage of gelatinisation. The process produces grain and seed which is more easily digestible which is especially important for consumer food products and feed for young animals, with greater nutritional value, improved flavour and improved appearance compared to grain and seed not having undergone the process.

Ideally all of the starch in the grain or seed would be gelatinised but this ideal has not been achieved using a Micronizing process.

Other processes such as extrusion have achieved a higher degree of starch gelatinisation. Extrusion can give around 90% starch gelatinisation. Nevertheless, extrusion is an expensive process to carry out on grain or seed compared to Micronizing.

According to a first aspect of the present invention, an apparatus for Micronizing grain or seed comprises a container in which a liquid and the grain or seed are provided and which is arranged to be vibrated to cause the grain or seed to absorb a high percentage of the liquid, an infra red source for generating infra red radiation to which the wetted grain or seed is subjected to cause gelatinisation of the starch in the grain or seed, in which at least 80% of the starch in the grain or seed is gelatinised

By treating the grain or seed using this apparatus, a much higher percentage of starch in the grain or seed is gelatinised than is possible with conventional Micronizing systems, giving an improved grain or seed. Furthermore, the control and predictability of the process is greatly improved over prior art systems, include the control of the final water content.

By vibrating the liquid and the grain or seed, the water content of the grain or seed is increased to a level much greater than that achievable by traditional steeping or soaking within a similar time period It is believed that this high water content results in the high percentage of starch gelatinisation which is achieved using the apparatus according to the present invention.

The treatment of the grain or seed by mixing with water and vibrating preferably gives a water content of between 25% and 30% by volume. To achieve this level of water content, the grain or seed may need to be mixed with water and vibrated a second or further time. In this case it is preferred that the grain or seed is allowed to temper or rest for a period between subsequent treatments. Preferably the grain or seed is tempered for at least two hours, and preferably for less than four hours.

It is not possible to achieve the high levels of water content required for the present application by soaking in water alone within such a short time period. It is known to increase the amount of liquid absorbed by grain or seed by introducing chemicals to the liquid, but in this case the chemicals will also be absorbed by the grain or seed and can reduce the quality of the grain or seed.

It is preferred that the water and grain or seed are mixed and vibrated using a VIBRONET (Trade Mark) available from Graf GmbH & Co, and as described in European Patent Application EP-A-0,596,022.

Preferably, the percentage of starch in the grain or seed which is gelatinised is greater than 90%, more preferably is at least 93% and even more preferably is around 95%.

It is preferred that the apparatus includes a residual cooking vessel in which the Micronized grain or seed can be stored at a temperature above ambient temperature. This improves the control of enzyme reduction in the grain or seed, and is particularly important for oats in which the Micronizing process causes the oil cells in the oats to become exposed and oxidised. This also applies to other cereals as well as pulses and beans, including soya. It is believed that the residual heating prevents this oxidation. Preferably the grain or seed is held in the residual heating vessel for at least 15 minutes. The present invention makes residual heating possible, since the high initial water content gives a high final water content, and therefore residual heating, which reduces water content can be performed without leading to an unacceptably low final water content.

Where a residual heating vessel is provided, it is preferred that this includes a temperature detecting means and a feedback arrangement to maintain the

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temperature of the grain or seed at a desired temperature

It is preferred that the apparatus includes a heating means to heat the grain or seed between water treatment and Micronizing. Preferably the heating means comprises a duct for extracting some of the heat from the infra red source, and using this to heat air which is blown over the grain or seed as these are introduced into the infra red radiation

Advantageously the grain or seed is dropped through a column into which the heated air is blown. The column preferably includes a series of baffles which deflect the grain or seed in a zigzag path. This slows the passage of the grain or seed through the column and thereby gives a longer time during which the heated air can heat the grain or seed. Preferably at least some of the baffles are perforated so that the heated air can pass through them to heat the grain or seed. Advantageously the baffles are inclined at an angle of around 30°.

Preferably the heating of the grain or seed increases the temperature of the grain or seed to between about 30 and 40°C above ambient temperature. Due to the pre-heating of the grain or seed, the speed at which the grain or seed can be Micronized is significantly increased, giving about a 30 to 40% increase in capacity of the apparatus. It has not previously been possible to pre-heat the grain or seed as this removes part of the water content of the grain or seed, and therefore would result in a low percentage of starch gelatinisation. However, according to the present invention, the water content of the grain or seed is raised to a higher level than is conventionally the case, and therefore it is possible to pre-heat the grain to improve the capacity without any significant decrease in the starch gelatinisation.

According to a second aspect of the present invention, a method of Micronizing grain or seed comprises the steps of increasing the water content of the grain or seed by mixing the grain or seed with water and vibrating the mixture, and subsequently subjecting the grain or seed to infra red radiation so that at least 80% of the starch in the grain or seed is gelatinised

Preferably the water content of the grain or seed is increased to between 25% and 30% by volume. It is preferred that at least 90% of the starch in the grain or seed is gelatinised. More preferably around 93% of the starch is gelatinised, and even more preferably around 95% is gelatinised

Preferably, the grain or seed is pre-heated prior to being subjected to infra red radiation. This increases the capacity of the Micronizing process. Advantageously the grain or seed is pre-heated to a temperature of between 30 and 40°C.

It is beneficial to maintain the micronized grain or seed at an elevated temperature after they are subjected to the infra red radiation. The grain or seed is preferably held at this elevated temperature for around 15 minutes

An example of the present invention will be described in accordance with the accompanying drawings, in which:

Figure 1 shows a schematic view of a Micronizing system according to the present invention;
Figure 2 shows a side view through part of a Micronizing apparatus according to the present invention; and,
Figure 3 shows a cross-sectional view through the grain or seed input shoot shown in the apparatus of Figure 2.

As shown in Figure 1, a vibratable container 1 is filled with a mixture of water and grain or seed to be processed. The vibratable container may be a VIBRONET (Trade Mark) available from Graf GmbH & Co. and as described in European Patent Application EP-A-0,598,022. The mixture of water with grain or seed is vibrated at a high frequency, typically of 72Hz, which causes a high percentage of water to be absorbed by the grain or seed. The grain or seed is then removed from the container 1, and is tempered in a tempering silo 2.

The absorbtion by the grain or seed of water causes the water content of the grain or seed to be increased, typically by around 8%. By repeating the treatment, additional water can be absorbed by the grain or seed, and therefore the grain or seed in the tempering silo 2 may be reintroduced into the vibrating container with additional water. This is repeated until the water content of the grain or seed is around 30% by volume. The grain or seed is then held in a feed hopper 12.

The treated grain or seed is then accurately deposited on the conveyor 3 via a feed hopper 12 of a conventional Micronizing apparatus to give an even spread on the conveyor. The grain or seed is conveyed through a region 5 of infra red radiation. The grain or seed remains in the infra red radiation for around 50 seconds for grain or seed which is subsequently to be flaked, or around 90 seconds for grain or seed which is to be torrefied. The infra red radiation may be generated by a series of gas burners 4 or electric element (not shown). As the grain or seed passes through the infra red radiation, the starch in the grain or seed is gelatinised. At least 80% of the starch in the grain or seed is gelatinised in this process, and typically between 90 and 95% of the starch is gelatinised.

After passing along the conveyor 3, the treated grain or seed is dropped into an outlet hopper 6. The outlet hopper 6 is in the form of a residual heating vessel in which the treated grain or seed is maintained at a high temperature for around 15 minutes. This residual heating helps reduce the enzymes in the finished product, and is particularly beneficial for the treatment of oats in which the oil cells are normally exposed during the Micronizing process and which are normally oxidised. To accurately maintain the temperature in the residual heating vessel, a thermostat or other temperature con-

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trol system (not shown) is included. The heating vessel 6 is insulated to reduce condensation and thereby improve consistency. The treated grain or seed is then cooled in a cooling vessel 13.

As shown best in Figure 2, a hood 7 is provided over the infra red source 4. The excess heat generated by the infra red source 4 rises into the hood 7 and into an outlet pipe 8. This heat is conveyed to an input shoot 9 where the heat is used to pre-heat the grain or seed as these are introduced to the infra red radiation. The vibrating container, tempering silo and hopper provided upstream of the input shoot 9 are not shown in Figure 2. The processed grain or seed may be flaked in a flaking mill 14, and is the cooled and exits to the left as shown in Figure 2.

As shown in Figure 3, the grain or seed falls through the input shoot of Figure 2 and is deflected along baffles 10,11. The baffles 10, 11 are arranged so that the grain or seed drops by gravity slowly downwards in a zigzag path, with the heated air passing over the grain or seed as it falls. To assist in the heating of the grain or seed, the inlet baffles 11 are perforated, allowing the heated air to pass through the baffles 11 and over the grain or seed on falling along the baffles 11. The baffles 10 are solid. All of the baffles 10,11 are arranged at an angle of 30° which ensures that the grain or seed falls at the optimum rate to be heated. The grain or seed is more effectively heated when they are on the perforated baffles 11, and therefore the gap between the bottom of each perforated baffle 11 and each underlying baffle 10 is smaller than the corresponding gap between each said baffle 10 and underlying baffle 11, thereby ensuring that the grain or seed spends more time on the perforated baffles 11.

The additional heating of the grain or seed increases the temperature of the grain or seed to between 30 and 40°C, which permits an increase in the capacity of the system of between 30 and 40%. The pre-heating of the grain and seed reduces the water content in the grain and seed by between 3 and 4%, however as a much higher percentage of water is introduced into the grain or seed by the use of the vibrating container 1, this loss is acceptable, and still allows a high percentage of starch gelatinisation compared to conventional systems.

The use of a vibrating container for increasing the water content of the grain or seed is also beneficial for the treatment of cocoa beans. In this case, it is known to Micronize the beans to break the outer husk. By initially increasing the water content of the beans, it has been found that the Micronizing process more easily removes the husk.

Claims

1. An apparatus for Micronizing grain or seed comprising a container (1) in which a liquid and the grain or seed are provided and which is arranged to be vibrated to cause the grain or seed to absorb a high percentage of the liquid, an infra red source (4) for generating infra red radiation to which the wetted grain or seed is subjected to cause gelatinisation of the starch in the grain or seed, in which at least 80% of the starch in the grain or seed is gelatinised.

2. An apparatus according to claim 1, in which the vibrating container (1) in which the water and grain or seed are mixed and vibrated is a VIBRONET (Trade Mark).

3. An apparatus according to claim 1 or 2, which further comprises a residual cooking vessel (6) in which the Micronized grain or seed can be stored at a temperature above ambient temperature.

4. An apparatus according to claim 3, in which the residual cooking vessel (6) includes a temperature detecting means and a feedback arrangement to maintain the temperature of the grain or seed at a desired temperature.

5. An apparatus according to any one of the preceding claims, further comprising a heating means to heat the grain or seed between water treatment and Micronizing.

6. An apparatus according to claim 5, in which the heating means comprises a duct for extracting some of the heat from the infra red source, and using this to heat air which is blown over the grain or seed as these are introduced into the infra red radiation.

7. An apparatus according to claim 6, further comprising a column into which the heated air is blown, the column including a series of baffles (10,11) which deflect the grain or seed in a zigzag path.

8. An apparatus according to claim 7, in which at least some of the baffles (10,11) are perforated so that the heated air can pass through them to heat the grain or seed.

9. An apparatus according to claim 7 or 8, in which the baffles (10,11) are inclined at an angle of around 30°.

10. A method of Micronizing grain or seed comprising the steps of increasing the water content of the grain or seed by mixing the grain or seed with water and vibrating the mixture, and subsequently subjecting the grain or seed to infra red radiation so that at least 80% of the starch in the grain or seed is gelatinised.

11. A method according to claim 10, in which the grain

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or seed is maintained at an elevated temperature for at least 15 minutes after Micronizing

12. A method according to claim 10 or 11, in which the grain or seed is preheated to between about 30 and 40°C above ambient temperature before it is vibrated with the water.

13. A method according to any one of claim 10 to 12, in which the water content of the grain or seed is increased to between 25% and 30% by volume.

14. A method according to any one of the preceding claims, in which the grain or seed is mixed with water and vibrated a second time.

15. A method according to claim 14, in which the grain or seed is allowed to temper or rest for a period between subsequent treatments.

16. A method according to claim 15, in which the grain or seed is tempered for at least two hours, and preferably for less than four hours.

17. A method according to any one of the preceding claims, in which the percentage of starch in the grain or seed which is gelatinised is greater than 90%.

18. A method according to any one of the preceding claims, in which the percentage of starch in the grain or seed which is gelatinised is greater than 93%.

19. A method according to any one of the preceding claims, in which the percentage of starch in the grain or seed which is gelatinised is greater than 95%.

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Fig.1

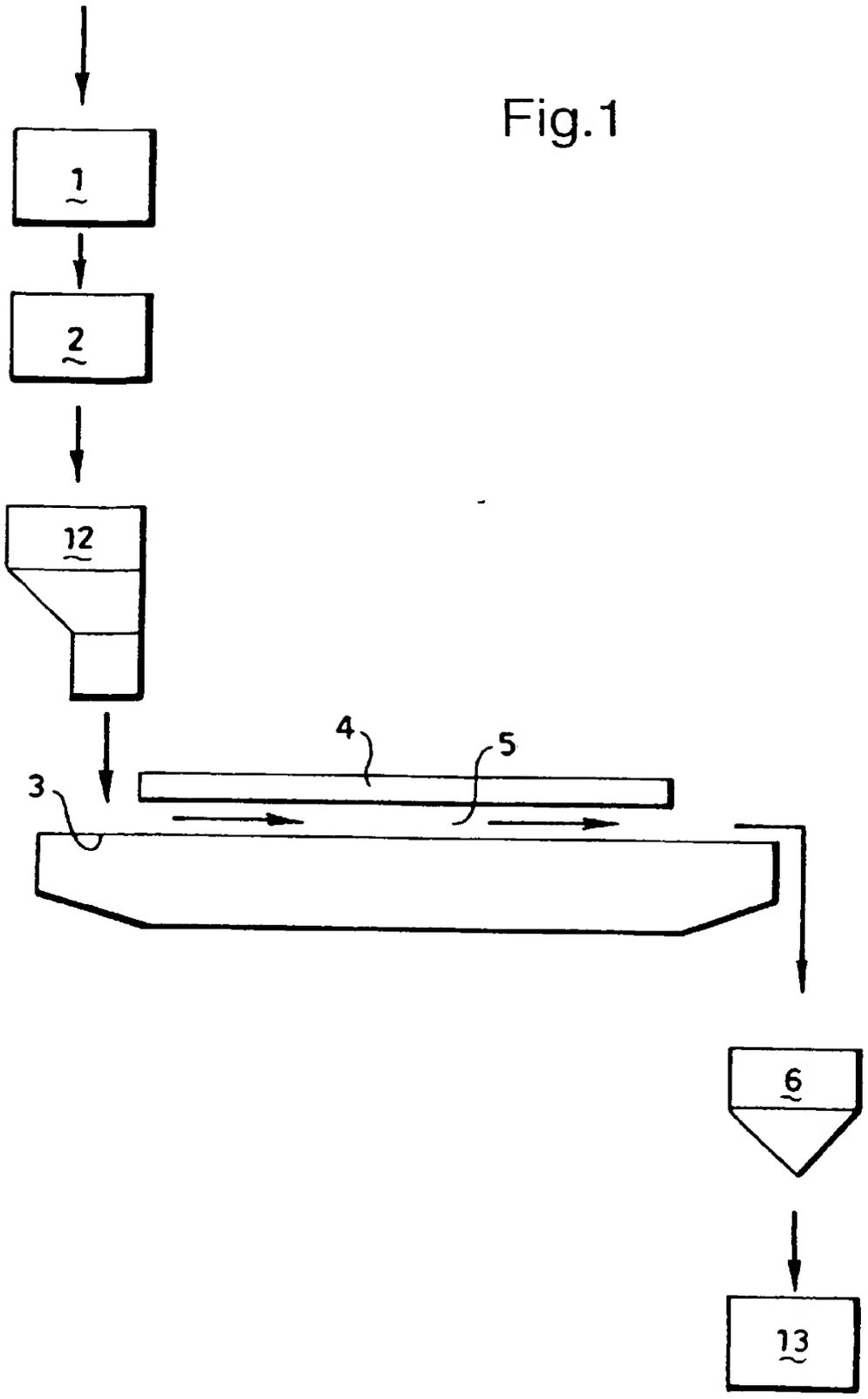

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Fig.2.

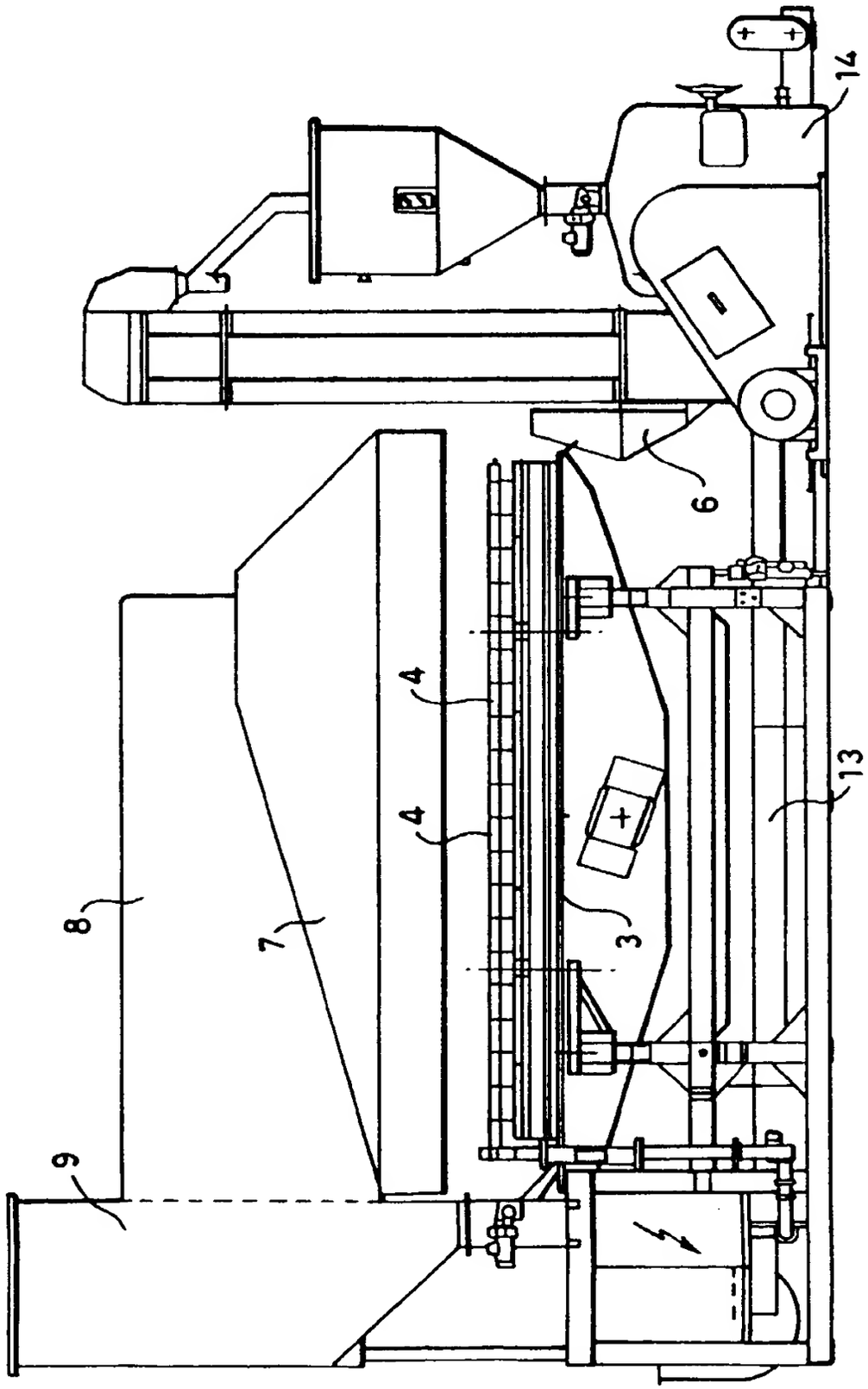

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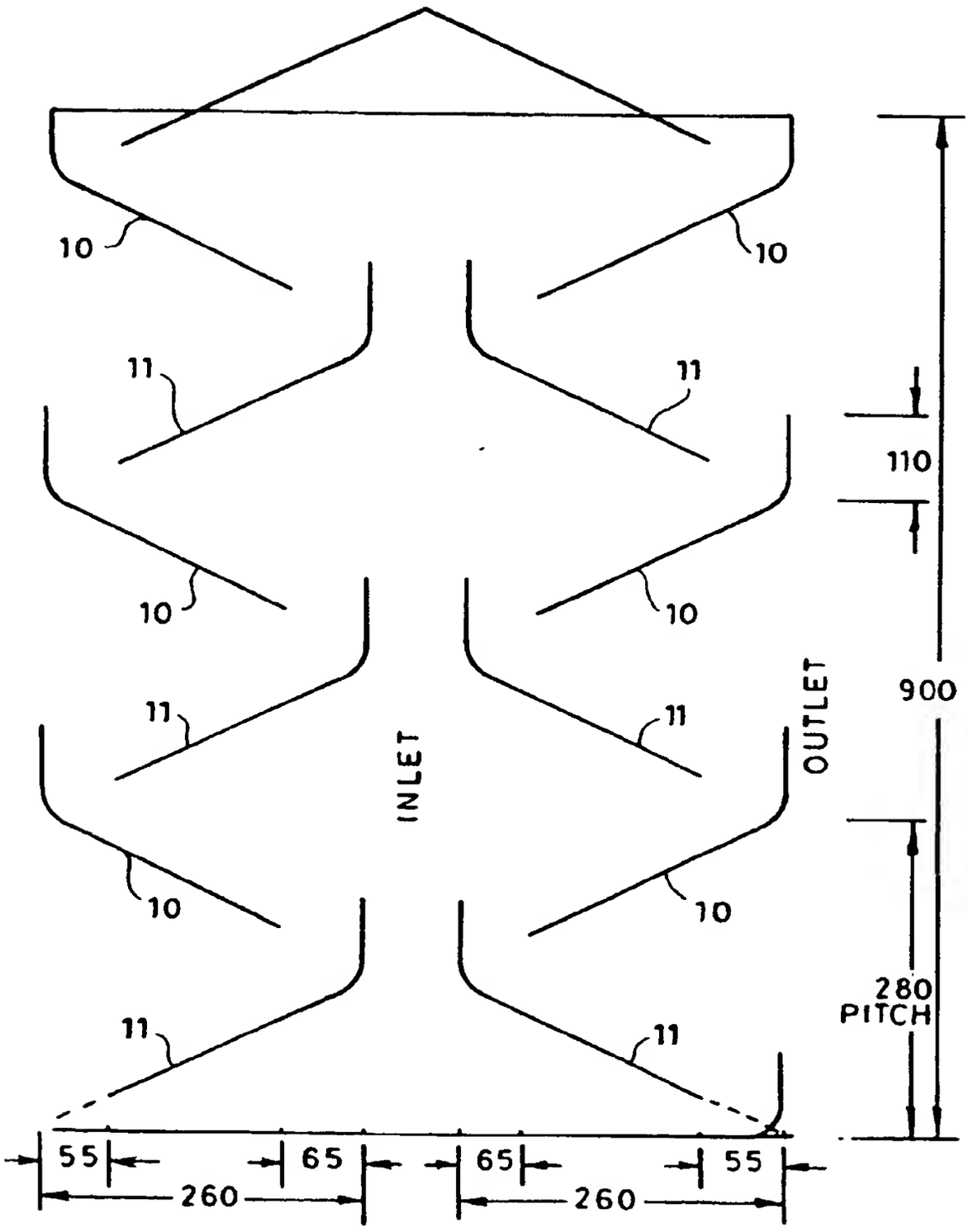
Fig.3.



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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 0884

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A,D	EP 0 598 022 B (GRAEF DIETER OTTO) 24 May 1995 * column 7, line 45 - column 8, line 35 *	1,2,10	A23L1/10 A23L1/182 B02B1/08
A	US 5 132 133 A (HUBER GORDON R ET AL) 21 July 1992 * the whole document *	1,3,10, 11,13, 17-19	
A	US 4 555 409 A (HART EDWIN R) 26 November 1985 * the whole document *	1,3,10, 11,13	
A	US 5 176 931 A (HERBSTER JEFFREY C) 5 January 1993 * claims *	1,3,10, 11,13	
A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 306 (C-0735), 3 July 1990 & JP 02 104249 A (OSAMU MATSUDA), 17 April 1990, * abstract *	1,7,9,10	
A	DATABASE WPI Section Ch, Week 9543 Derwent Publications Ltd., London, GB; Class D13, AN 95-335077 XP002067009 & RU 2 030 882 C (GRAIN AND PRODUCTS RES INST) * abstract *	1,10,13	

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TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A23L
B02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 June 1998	Merckx, A

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
Y particularly relevant if combined with another document of the same category
A technological background
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E earlier patent document, but published on, or after the filing date
D document cited in the application
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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 0884

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 6)
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A	DATABASE WPI Section Ch, Week 9233 Derwent Publications Ltd., London, GB; Class D14, AN 92-275043 XP002067011 & SU 1 678 298 A (KAZA BALANCED FODDER IND RES INST) * abstract *	1,10	
A	FR 2 193 551 A (NEWTON DAVID) 22 February 1974 * claims *	1,10	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 June 1998	Merckx, A

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
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A technological background
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& member of the same patent family, corresponding document

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